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10/600,777	06/20/2003	Gordon W. Breuker	MHR01 P-301	5947

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EXAMINER	
COOLEY, CHARLES E	
ART UNIT	**PAPER NUMBER**
1723	

DATE MAILED: 05/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/600,777	BREUKER ET AL.	
	Examiner	Art Unit	
	Charles E. Cooley	1723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 December 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-58* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-58* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *20 June 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *06202003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

NON-FINAL OFFICE ACTION

1. This application has been assigned to Technology Center 1700, Art Unit 1723 and the following will apply for this application:

Please direct all written correspondence with the correct application serial number for this application to Art Unit 1723.

Telephone inquiries regarding this application should be directed to the Electronic Business Center (EBC) at http://www.uspto.gov/ebc/index.html or 1-866-217-9197 or to the Examiner at (571) 272-1139. All official facsimiles should be transmitted to (703) 872-9306.

2. As the PTO continues to move towards a fully electronic environment, the office will phase-in its E-Patent Reference program. This program: (1) provides downloading capability of the U.S. patents and U.S. patent application publications cited in Office actions via the E-Patent Reference feature of the Office's PAIR system; and (2) ceases mailing paper copies of U.S. patents and U.S. patent application publications with office actions except for citations made during the international stage of an international application under PCT.

Effective June 2004, paper copies of cited U.S. patents and U.S. patent application publications will cease to be mailed to applicants with Office actions from this Technology Center. Paper copies of foreign patents and non-patent literature will continue to be included with office actions.

The U.S. patents and patent application publications cited in office actions are available for download via the Office's PAIR system. As an alternate source, all U.S.

patents and patent application publications are available on the USPTO web site (www.uspto.gov), from the Office of Public Records and from commercial sources. Inquiries about the use of the Office's PAIR system should be referred to the Electronic Business Center (EBC) at http://www.uspto.gov/ebc/index.html or 1-866-217-9197.

Requests to restart a period for response due to a missing U.S. patent or patent application publications will not be granted.

Information Disclosure Statement

3. Note the attached PTO-1449 form(s) submitted with the Information Disclosure Statement filed 20 JUN 2003.

Drawings

4. The drawings are objected to because of the following informalities:

a. Figures 5-7 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g).

Correction is required.

5. Applicant should verify that (1) all reference characters in the drawings are described in the detailed description portion of the specification and (2) all reference characters mentioned in the specification are included in the appropriate drawing Figure(s) as required by 37 CFR 1.84(p)(5).

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

Replacement Drawing Sheets

Drawing changes must be made by presenting replacement figures which incorporate the desired changes and which comply with 37 CFR 1.84. An explanation of the changes made must be presented either in the drawing amendments, or remarks, section of the amendment. Any replacement drawing sheet must be identified in the top margin as "Replacement Sheet" (37 CFR 1.121(d)) and include all of the figures appearing on the immediate prior version of the sheet, even though only one figure may be amended. The figure or figure number of the amended drawing(s) must not be labeled as "amended." If the changes to the drawing figure(s) are not accepted by the examiner, applicant will be notified of any required corrective action in the next Office action. No further drawing submission will be required, unless applicant is notified.

Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin.

Annotated Drawing Sheets

A marked-up copy of any amended drawing figure, including annotations indicating the changes made, may be submitted or required by the examiner. The annotated drawing sheets must be clearly labeled as "Annotated Marked-up Drawings" and accompany the replacement sheets.

Timing of Corrections

Applicant is required to submit acceptable corrected drawings within the time period set in the Office action. See 37 CFR 1.85(a). Failure to take corrective action within the set period will result in ABANDONMENT of the application.

If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings MUST be filed within the THREE MONTH shortened statutory period set for reply in the "Notice of Allowability." Extensions of time may NOT be obtained under the provisions of 37 CFR 1.136 for filing the corrected drawings after the mailing of a Notice of Allowability.

Specification

6. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

7. The abstract is acceptable.

8. The title is acceptable.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 1, 2, 7-14, 25-26, 31-41 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Schneider (US 5,063,027).

The patent to Schneider (US 5,063,027) discloses the recited apparatus and method - see Figs. 2-4. More particularly, the patent to Schneider '027 discloses an apparatus for mixing two or more components and more particularly to a method and device for high pressure impingement mixing of two or more reactive components. The components are injected into a mixing chamber containing a reciprocating piston. The mixing chamber opens into a quieting chamber also containing a reciprocating cleaning piston.

The mixing chamber is arranged at an acute angle (alpha) to the quieting chamber so that the components undergo a change in direction of over 90 degrees. Advantageously alpha is significantly less than 90 degrees (which is of a scope considered to encompass the angular ranges recited in the claims).

The apparatus is for mixing at least two reactive plastic components under high pressure in a cylindrical mixing chamber. The plastic components are injected into the mixing chamber containing a reversible piston. The piston serves to control the flow of the components, i.e., duration of a shot and recirculation, and to clean the chamber by ejection of reactive plastic residues at the end of a shot. A cylindrical quieting chamber follows the mixing chamber and extends at an angle to the longitudinal axis of said mixing chamber. The quieting chamber contains a reversible piston. The mixing chamber and potentially one or more additional mixing chambers are arranged at an acute angle which may be significantly smaller than 90 degrees to the quieting chamber in a direction against the output direction of said quieting chamber. The angle may be within a range of about 30 to 60 degrees and may approximate or be 45 degrees. A reversible or reciprocating mixing chamber piston may exhibit a longitudinal groove for each plastic component defining a recirculation path for the plastic or reactive component involved between two successive injections or shots. The openings of the mixing chambers may advantageously be all located in a common radial plane of the quieting chamber.

It is advantageous to a control a mixing device so that in a first mode of operation (mixing position) the mixing chamber piston releases the injection of the reactive plastic

components and the other piston partially closes the outlet opening of the mixing chamber (throttling position). According to an alternative mode of operation the mixing chamber piston may be retracted to release the injection of the reactive plastic components into the mixing chamber and the second piston is retracted to a position past the outlet opening of the mixing chamber so that a swirl or mixing space is formed between the frontal surface of the second piston and the outlet opening of the mixing chamber.

The invention is based on the concept of letting one or several mixing chambers open at an acute angle into the quieting chamber in a direction against or to a degree opposite the output direction of the quieting chamber. Preferably all mixing chambers are arranged in a common radial plane. The component mixture or mixtures introduced into the quieting chamber thereby undergo additional intensive mixing by the reverse flow forced upon them. Simultaneously the generation of a spinning flow in the outlet tube is counteracted.

The partial view shown in FIG. 1 of a known mixing head contains a cylindrical mixing chamber 1. A component inlet line 2 for a plastic or reactive component A and a component inlet line 3 for a plastic or reactive component B open into the mixing chamber. The injection orifices 4 and 5 of these component inlet lines 2 and 3 are opened and closed by the mixing chamber piston 6. The piston is guided reversibly or reciprocates in the mixing chamber. The mixing chamber piston 6 is in the mixing position, in which the injection orifices 4 and 5 are open, so that the plastic components A and B meet at high pressure and are mixed intensively. In a recirculating position (not

shown) the mixing chamber piston is in an advanced position in which its frontal surface 7 closes the outlet opening 8 of the mixing chamber 1 in a flush manner. When the mixing piston is advanced, the component inlet lines 2 and 3 are connected to or in communication with component return lines 11 and 12 through the recirculating grooves 9 and 10 provided in the mixing chamber piston 6. The components A and B are returned into tanks or reservoirs in the nonmixing or recirculating position. In the mixing phase shown in FIG. 1 the reactive plastic mixture enters the quieting chamber 13 through the outlet opening 8 after a right angle deflection from the mixing chamber 1. A second reciprocating piston 14 is located in the quieting chamber. The piston 14 is shown in a throttling position partially covering the outlet opening 8. The plastic mixture exits at right angles from the mixing chamber in both a throttling and a completely open position of the piston 14 and impacts the wall opposite the outlet opening 8 of the quieting chamber 13. The mixture may tend to continue in a spinning flow D, whereby the flow of the plastic spreads out upon leaving the outlet opening 15 of the quieting chamber 13, thereby producing a spray (arrows 16). This spraying is particularly undesirable in the molding of plastic mixtures or polyurethane foam in open molds, as this may result in the formation of unacceptable air inclusions or bubbles in the finished product.

The above described problems of the devices according to the previous state of the art (FIG. 1) are eliminated by locating a mixing chamber 101 at an acute angle alpha (FIG. 2), as the plastic mixture leaving the mixing chamber 101 flows initially at this acute angle alpha against the outflow direction of the subsequent quieting chamber 113

and is aligned by reversal and flowthrough into a laminar flow of the plastic mixture. A quieted flow with flow components coaxial relative to the axis of the quieting chamber 113 (arrows 116) appears at the outlet opening 115 of the quieting chamber 113. Air inclusions due to a spray flow, as indicated in FIG. 1 by the arrows 16, can be largely avoided. Further, a mixing device with such a "y" configuration allows ease of manipulation which may be important for many applications. This is particularly so in open mold applications where maneuverability of the mixing device before, during and after a pour may be required. Maneuvering ease of the mixing device between mold parts may be greatly enhanced by the slim "y" configuration.

FIG. 3 shows the apparatus according to the invention in the mixing position with a piston 214 further retracted over the outlet opening 208 of the mixing chamber 201. The space vacated by the retracted piston leaves a significantly larger swirling space between the frontal surface of the piston 214 and the outlet opening 208 relative to the configuration shown in FIG. 2 where the quieting chamber piston is aligned in a throttling position. The piston 206, located reversibly in the mixing chamber 201, is rotated 90 degrees compared to the embodiment according to FIG. 1, so that only one recirculating groove 209 is visible. A corresponding recirculating groove is located opposite to groove 209. Similarly, in the view according to FIG. 2 and 3 only one injection orifice 103 or 203 is visible.

FIG. 4 shows a mixing apparatus in a nonmixing phase. Two mixing chambers 301 and 301' open into a quieting chamber 313. Pistons 306 and 306' are reciprocal in the chambers 301 and 301' . The pistons are shown in the closed or recirculation

position, in which the plastic components A and B (FIG. 1) are returned through the recirculating grooves 309 and 309' and the opposing recirculating grooves (not shown) into respective component tanks. The piston 314 located in the quieting chamber 313 is in the foremost or advanced position, in which the plastic mixture, initially put out from the mixing chambers 301 and 301' and ejected by the pistons 306 and 306' in a cleaning stroke, is removed from the quieting chamber 313 at the end of a completed shot.

With respect to claim 41, this patent incorporates U.S. Pat. No. 4,115,299 (the patent to Muhle, cited herein) by reference (see col. 1, lines 16-20) which teaches mixing two reactive materials such as polyol and isocyanate (Muhle: col. 3, lines 11-15).

11. Claims 15, 20, 21, 42, 50, 51, 52, 53, 57, and 58 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Schneider (US 4,440,500).

The patent to Schneider (US 4,440,500) discloses the recited apparatus and method - see Figs. 1-4. The housing 10 has an input mix chamber passageway (the horizontal passage between the end faces of 24 and 34 as seen in Figs. 3-4) and an output passageway 12, the input mix chamber passageway communicating with the output passageway (Fig. 4); a first nozzle 52 or 53 for injecting a first fluid into the input mix chamber passageway; and a second nozzle 62 or 64 for injecting a second fluid into the input mix chamber passageway whereby the second fluid can mix with the first fluid to form a mixed fluid; the first nozzle being configured to inject the first fluid into the

input mix chamber passageway along a first axial line A-B; the second nozzle being configured to inject the second fluid into the input mix chamber passageway along a second axial line C-D; wherein the first nozzle and the second nozzle are configured to inject the first fluid and the second fluid into the input mix chamber passageway such that the first fluid and the second fluid meet at an intersection point 32; and wherein thee first axial line and the second axial line are not collinear (Fig. 3); wherein the first axial line and the second axial line are not coplanar (Figs. 3 and 4); and wherein the intersection point 32 is not located along a longitudinal axis of the input mix chamber passageway (Figs. 1 and 4); cleanout piston rod 14; input mix chamber passageway piston rods 24 and/or 34.

More particularly, the patent to Schneider '500 discloses a device for high velocity impingement mixing and dispensing of two or more liquid polymeric reactants, for example polyurethane, in which the mixed reactants are dispensed into a mold cavity or onto a surface.

The invention is a high pressure impingement mixing apparatus for mixing and dispensing two or more liquid components, which provides effective and thorough mixing of reactants and which dispenses a thoroughly mixed, laminar flow emulsion. The device may be used in place of known high pressure reaction injection molding systems without the need for utilizing conventional aftermixers and film gates. The device may also effectively be used in place of low pressure mixing systems in open mold operations, where due to the materials involved high pressure mixing apparatus has heretofore been ineffective.

More particularly, a high pressure impingement mixing apparatus in accordance with the invention includes a mixing chamber, into which two or more reactants are injected at high velocity, an integral aftermixer chamber arranged to receive the output from the mixing chamber and perpetuate turbulence conditions to effect thorough mixing, and a transfer dispense chamber arranged to receive the mixture from the aftermixer chamber, convert the flow from turbulent to laminar, and thereafter dispense the mixed reactants.

In a preferred embodiment, a mixing head includes a transfer dispense chamber with a hydraulically actuated cleaning plunger therein. The mixing chamber, which receives the reactants, is arranged at right angles to the transfer dispense chamber. Apparatus for introducing the reactants into the mixing chamber for impingement mixing, and for selectively interrupting the delivery of the components, are known. Delivery and interruption of the components is controlled by a hydraulically actuated plunger arranged in the mixing chamber, which when moved to its extended position to block mixing, also purges the mixing chamber of mixed components remaining therein.

The mixing head also includes the cylindrical aftermixture chamber, with a correspondingly arranged hydraulically actuated cleaning plunger. The axis of the impingement mixing chamber meets the axis of the cylindrical transfer dispensing chamber at a right angle. The aftermixer chamber is also at right angles to the transfer dispense chamber. The mixing and aftermixer chambers are arranged on opposite sides of the transfer dispense chamber, such that the output from the mixing chamber is directed across the transfer dispense cylinder into the aftermixer chamber. The

aftermixer chamber has a larger diameter than the mixing chamber. Preferably, the center of the cylindrical aftermixer chamber is such that the flow stream exiting the mixing chamber is directed into the lower portion of the aftermixer chamber.

For dispense operation, the various devices of the mixing apparatus are actuated in the sequence as described below. First, the transfer dispense chamber is opened by retracting the dispense plunger. Second, the aftermixer chamber is opened by retracting the aftermixer plunger. And third, preferably simultaneously with the opening of the aftermixer chamber, the mixing chamber is opened by retracting the cleaning plunger of the mixing device. With the retraction of the mixing chamber plunger, impingement mixing is initiated by the opening of the impingement nozzles to the mixing chamber. The materials dispensed from the mixing chamber leaves the mixing chamber, which is relatively small in cross-sectional diameter, at a relatively high speed and is directed across the transfer dispense chamber where it enters the lower section of the aftermixer chamber.

Once the flow enters the aftermixer chamber, the material encounters the rear wall of the aftermixture chamber (the front face of the aftermixer plunger), where it is deflected back towards the transfer dispense chamber. The deflection occurs mainly in the upper direction because of the arrangement of the chamber and geometry, and the diverted flow is directed back into the upper portion of the transfer dispense chamber. From there, the flow has to pass around the flow stream traveling between the mixing chamber and the aftermixer chamber (i.e. crossing the transfer dispense chamber). Thus, the flow stream exiting the impingement mixing device is initially transferred

across the transfer dispense chamber, to the aftermixer chamber, and thereafter returned to the transfer dispense chamber to be dispensed.

An arrangement in accordance with the invention effects highly turbulent flow conditions, not only in the original mixing chamber, but also in the aftermixer chamber and the upper section of the transfer dispense chamber. The turbulence is maintained by the deflection pattern of the flow stream in the aftermixer, which is facilitated both by the deflection of the flow and also by the continuous counterflowing conditions of the materials in the aftermixer chamber. Turbulence is also maintained in that the mixture, upon exiting the aftermixer chamber and re-entering the transfer dispense chamber, is disposed above the high velocity crossing flow of components leaving the mixing chamber, and to reach the transfer dispense cylinder outlet must flow around this crossing flow. A liquid particle passes statistically several times through the turbulence area before it enters, finally, the transfer dispense chamber.

Once in the transfer dispense chamber and having flowed around the high speed mixing chamber crossing flow, in accordance with the law of continuity the flow in the transfer dispense chamber is slowed down proportionately to the relationship of the flow areas. Prior to reaching the dispensing chamber outlet, the flow pattern becomes laminar so as to leave the dispense opening in a steady, non-splashing stream.

To terminate a mixing cycle, the various plungers are actuated in a reverse sequence. The mixing chamber piston is moved to its extended position, to block the further delivery of reactants into the mixing chamber, thereby terminate mixing, at the same time pushing out the reactants in the mixing chamber. The aftermixer plunger is

then moved to its extended position, to clean out mechanically the aftermixer chamber, and finally the cleaning plunger of the dispense mechanism is actuated for reaming out the remnant material in the transfer dispense chamber.

If desired, the mixing apparatus can incorporate delivery systems for further liquid or gaseous components, for example, coloring agents, catalysts, blowing agents, air or nitrogen. Advantageously, such additives are dispensed into the mixture in the afterchamber, where they are mixed with the main components while the main components are still in turbulent flow conditions.

Referring to FIGS. 1 and 2, a mixing head housing 10 includes a transfer dispense chamber 12, with a cleaning plunger 14 arranged therein, having an outlet 13 for dispensing mixed components. The cleaning plunger 14 is selectively extendable between a retracted position (shown) and an extended position by a piston 16 enclosed in a cylinder 18. The cleaning plunger 14 is actuated by introduction of hydraulic fluid into the port hole 19 or 20

The mixing head housing 10 is also provided with a mixing chamber 22, in which is disposed a cleaning plunger 24. The plunger 24 is displaceable between the retracted position (shown) and an extended position, in which the front face of the plunger 24 extends to the transfer dispense chamber 12, by an actuating piston 26. The mixing chamber piston 26 is enclosed in a cylinder 28, and actuated by the introduction of hydraulic fluid in the port hole 29 or 30. Opposite to the mixing chamber 22 is located an aftermixer chamber 32, which as shown is larger in diameter than the mixing chamber 22. A cleaning plunger 34 is disposed in the aftermixer chamber 32 and is selectively

displaceable between the retracted position (shown) and an extended position in which the front face 35 thereof extends to the dispense transfer chamber 12. The plunger 34, through an associated piston 36 disposed in a cylinder 38, is movable between the retracted and extended positions by hydraulic fluid introduced through port hole 39 or 40.

Referring to FIG. 2, the mixing head housing 10 further includes injection devices 42 and 44 for introducing two pressurized main components "A" and "B" to the mixing chamber 22 for impingement mixing. Preferably each of the injection devices 42 and 44 has structure as shown and described in my prior U.S. Pat. No. 4,239,732, the pertinent portions of which are incorporated herein by reference. In such an arrangement, the two main components "A" and "B" are provided from their respective reservoirs 45 under pressure, by pumps to inlets 46 and 48. The inlets communicate with a longitudinally displaceable plunger 50, each having a longitudinal passage therethrough, such that the individual reactants "A" and "B" pass through the plunger passage and exit the forward end.

In the mixing position shown, where plunger 24 is in the retracted position, the forward ends of the plungers 50 are pressed forward, by the force of the pressurized fluid passing therethrough, against nozzle orifices 52 and 53, which open into the mixing chamber 22. The pressurized components "A" and "B" are accelerated through the nozzle openings 52 and 53 such that the reactive materials are impinged at high velocity in the mixing chamber 22.

Mixing is initiated and interrupted by the retraction and extension of the plunger 24. As the plunger 24 moves to the extended position, flow through the nozzle inlets 52 and 53 is simultaneously blocked to interrupt delivery of the reactants to the chamber 22. Blocking of the flow through the inlet openings 52 and 53 causes the plungers 50 to retract to initiate recirculation of the flowing components "A" and "B" through recirculation lines 56 and 58. Correspondingly, when the plunger 24 is again retracted to initiate mixing, pressure in the reactant delivery plungers 50 causes the plungers 50 to move forward to direct the already flowing component (recirculating) into the mixing chamber. Mixing is initiated and interrupted without lead lag problems, and without creating pressure fluctuations or pulses in the metering systems.

As shown in FIG. 2, the transfer dispense housing 10 may include additional orifices 58 and 60, for introducing additional components "C" and "D" into the aftermixer chamber 32, through inlets 62 and 64, when plunger 34 is retracted.

FIGS. 1-4 show the mixing apparatus in the open, mixing position. The primary components "A" and "B" are supplied by the metering pumps at a pressure of approximately 1500 to 3000 psi to the inlets 46 and 48. FIGS. 3 and 4 illustrate the flow stream of the mixed material. For purposes of simplification, the injection apparatus 42 and 44 are omitted in these figures. The components "A" and "B" enter the mixing chamber, through the inlets 52 and 53, at relatively high velocity. The flow stream of mixed material thereafter leaves the mixing chamber 22 with a relatively high speed (20-50 ft/sec) and is shot across the transfer dispense chamber 12 into the aftermixer chamber 32.

In the aftermixer chamber 32, the flow stream is deflected by 180 degrees at the front face 35 of the cleaning plunger 34. Highly turbulent conditions are achieved. The mixed material is recirculated statistically several times in the area shown in FIGS. 3 and 4 until it is finally discharged at the outlet opening 13 of the transfer dispense chamber 12. As shown in the figures, in addition to the mixing encountered in the aftermixer chamber 32, the mixed material, once it leaves the aftermixer chamber 32, back into the transfer dispense chamber 12, is disposed above the crossing flow from the mixing chamber 22, and thereafter must flow around the crossing flow as it travels toward the discharge opening 13 of the dispense chamber 12. Thus, turbulence is enhanced by the reversal of flow in the aftermixer chamber 32, the counter-flowing mixtures in the chamber 32, and the interaction of the exiting and crossing mixtures in chamber 12.

The dispense transfer chamber 12 is designed to have a length sufficient to allow transition from turbulent to laminar flow conditions prior to the mixed reactants reaching the outlet. The discharge speed can be low as approximately 2 to 5 ft./sec. depending upon the capacity and the flow area.

If the mixing apparatus is provided with inlet nozzles 62 and 64, additional components may be introduced into the turbulent mixture in the aftermixer chamber 32. Such additives can include coloring agents, catalysts, blowing agents, air, or nitrogen.

At the end of a dispense cycle, the operation is interrupted by first moving the mixing chamber plunger 24 to its extended position. Such will block the outlets 52 and 53, and cause the injection devices 42 and 44 to initiate recirculation. The plunger is

extended to a position to be flush with the dispense transfer chamber 22, to mechanically clean out the bore of the mixing chamber 22 of reactant mixture. Once the delivery of the components "A" and "B" is interrupted, the aftermixer plunger 34 is actuated to move it to its extended position. Extension of the plunger 34 likewise cleans the aftermixer chamber 32 of mixed components, pushing such components into the transfer dispense chamber 12. If additional components are being introduced through inlets 60 and 62, extension of the plunger 34 interrupts further delivery of such components. Finally, when both plungers 22 and 34 have been moved to be flush with transfer dispense chamber 12, the transfer dispense plunger 14 is moved to its extended position to push out the remaining mixed reactants from the transfer dispense chamber 12. Thus, the plungers 24, 34 and 14 act to effectively ream out the mixed reactants and clean the device for the next cycle.

To reinstitute the pouring (open mold) or dispensing (closed mold) operation, the plunger 14 is retracted, and after a brief time delay, the cleaning plunger 34 of the aftermixer chamber 32 and the cleaning plunger 24 of the mixing chamber 22 are retracted. This starts immediately the impingement of the reactive components through the orifices 52 and 53 in the mixing chamber 22. If additional components are to be supplied through inlets 60 and 62, the plungers 24 and 34 are preferably retracted simultaneously.

The axes of the mixing chamber 22 and aftermixer chamber 32 are shown as parallel, and the mixing chamber 22 is arranged to be opposite the lower portion of the

aftermixer chamber 32, modifications of the flow direction of the premixed material to the after-chamber, can be made for optimizing the turbulence effect.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

14. Claim 54 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schneider (US 4,440,500) in view of Muhle (US 4,115,299).

Schneider (US 4,440,500) suggests the use of the mixing head for mixing polymeric reactants, for example polyurethane (col. 1, lines 6-9) but does not disclose

the particular materials of polyol and isocyanate. Muhle teaches using a similar mixing head to mix two reactive materials such as polyol and isocyanate for producing polyurethane (col. 3, lines 11-16). In view of the suggestion in Schneider (US 4,440,500) for using the mixing head thereof for mixing polymeric reactants, for example polyurethane, it would have been obvious to one having ordinary skill in the art, at the time applicant's invention was made in view of the teachings of Muhle to have implemented polyol and isocyanate in the method of Schneider (US 4,440,500) for the purpose of producing polyurethane.

15. Claims 16-19, 22-24, 43-49, and 55-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schneider (US 4,440,500) in view of Schneider (US 5,063,027).

The patent to Schneider (US 4,440,500) discloses all of the recited subject matter as noted above with the exception of the input mix chamber passageway being non-perpendicular or at an acute angle to the outlet passageway.

The patent to Schneider (US 5,063,027) discloses an apparatus for mixing two or more components and more particularly to a method and device for high pressure impingement mixing of two or more reactive components. The components are injected into a mixing chamber containing a reciprocating piston. The mixing chamber opens into a quieting chamber also containing a reciprocating cleaning piston.

The mixing chamber is arranged at an acute angle (alpha) to the quieting chamber so that the components undergo a change in direction of over 90 degrees.

Advantageously alpha is significantly less than 90 degrees (which is of a scope considered to encompass the angular ranges recited in the claims).

The apparatus is for mixing at least two reactive plastic components under high pressure in a cylindrical mixing chamber. The plastic components are injected into the mixing chamber containing a reversible piston. The piston serves to control the flow of the components, i.e., duration of a shot and recirculation, and to clean the chamber by ejection of reactive plastic residues at the end of a shot. A cylindrical quieting chamber follows the mixing chamber and extends at an angle to the longitudinal axis of said mixing chamber. The quieting chamber contains a reversible piston. The mixing chamber and potentially one or more additional mixing chambers are arranged at an acute angle which may be significantly smaller than 90 degrees to the quieting chamber in a direction against the output direction of said quieting chamber. The angle may be within a range of about 30 to 60 degrees and may approximate or be 45 degrees. A reversible or reciprocating mixing chamber piston may exhibit a longitudinal groove for each plastic component defining a recirculation path for the plastic or reactive component involved between two successive injections or shots. The openings of the mixing chambers may advantageously be all located in a common radial plane of the quieting chamber.

It is advantageous to a control a mixing device so that in a first mode of operation (mixing position) the mixing chamber piston releases the injection of the reactive plastic components and the other piston partially closes the outlet opening of the mixing chamber (throttling position). According to an alternative mode of operation the mixing

chamber piston may be retracted to release the injection of the reactive plastic components into the mixing chamber and the second piston is retracted to a position past the outlet opening of the mixing chamber so that a swirl or mixing space is formed between the frontal surface of the second piston and the outlet opening of the mixing chamber.

The invention is based on the concept of letting one or several mixing chambers open at an acute angle into the quieting chamber in a direction against or to a degree opposite the output direction of the quieting chamber. Preferably all mixing chambers are arranged in a common radial plane. The component mixture or mixtures introduced into the quieting chamber thereby undergo additional intensive mixing by the reverse flow forced upon them. Simultaneously the generation of a spinning flow in the outlet tube is counteracted.

The partial view shown in FIG. 1 of a known mixing head contains a cylindrical mixing chamber 1. A component inlet line 2 for a plastic or reactive component A and a component inlet line 3 for a plastic or reactive component B open into the mixing chamber. The injection orifices 4 and 5 of these component inlet lines 2 and 3 are opened and closed by the mixing chamber piston 6. The piston is guided reversibly or reciprocates in the mixing chamber. The mixing chamber piston 6 is in the mixing position, in which the injection orifices 4 and 5 are open, so that the plastic components A and B meet at high pressure and are mixed intensively. In a recirculating position (not shown) the mixing chamber piston is in an advanced position in which its frontal surface 7 closes the outlet opening 8 of the mixing chamber 1 in a flush manner. When the

mixing piston is advanced, the component inlet lines 2 and 3 are connected to or in communication with component return lines 11 and 12 through the recirculating grooves 9 and 10 provided in the mixing chamber piston 6. The components A and B are returned into tanks or reservoirs in the nonmixing or recirculating position. In the mixing phase shown in FIG. 1 the reactive plastic mixture enters the quieting chamber 13 through the outlet opening 8 after a right angle deflection from the mixing chamber 1. A second reciprocating piston 14 is located in the quieting chamber. The piston 14 is shown in a throttling position partially covering the outlet opening 8. The plastic mixture exits at right angles from the mixing chamber in both a throttling and a completely open position of the piston 14 and impacts the wall opposite the outlet opening 8 of the quieting chamber 13. The mixture may tend to continue in a spinning flow D, whereby the flow of the plastic spreads out upon leaving the outlet opening 15 of the quieting chamber 13, thereby producing a spray (arrows 16). This spraying is particularly undesirable in the molding of plastic mixtures or polyurethane foam in open molds, as this may result in the formation of unacceptable air inclusions or bubbles in the finished product.

The above described problems of the devices according to the previous state of the art (FIG. 1) are eliminated by locating a mixing chamber 101 at an acute angle alpha (FIG. 2), as the plastic mixture leaving the mixing chamber 101 flows initially at this acute angle alpha against the outflow direction of the subsequent quieting chamber 113 and is aligned by reversal and flowthrough into a laminar flow of the plastic mixture. A quieted flow with flow components coaxial relative to the axis of the quieting chamber

113 (arrows 116) appears at the outlet opening 115 of the quieting chamber 113. Air inclusions due to a spray flow, as indicated in FIG. 1 by the arrows 16, can be largely avoided. Further, a mixing device with such a "y" configuration allows ease of manipulation which may be important for many applications. This is particularly so in open mold applications where maneuverability of the mixing device before, during and after a pour may be required. Maneuvering ease of the mixing device between mold parts may be greatly enhanced by the slim "y" configuration.

FIG. 3 shows the apparatus according to the invention in the mixing position with a piston 214 further retracted over the outlet opening 208 of the mixing chamber 201. The space vacated by the retracted piston leaves a significantly larger swirling space between the frontal surface of the piston 214 and the outlet opening 208 relative to the configuration shown in FIG. 2 where the quieting chamber piston is aligned in a throttling position. The piston 206, located reversibly in the mixing chamber 201, is rotated 90 degrees compared to the embodiment according to FIG. 1, so that only one recirculating groove 209 is visible. A corresponding recirculating groove is located opposite to groove 209. Similarly, in the view according to FIG. 2 and 3 only one injection orifice 103 or 203 is visible.

FIG. 4 shows a mixing apparatus in a nonmixing phase. Two mixing chambers 301 and 301' open into a quieting chamber 313. Pistons 306 and 306' are reciprocal in the chambers 301 and 301' . The pistons are shown in the closed or recirculation position, in which the plastic components A and B (FIG. 1) are returned through the recirculating grooves 309 and 309' and the opposing recirculating grooves (not shown)

into respective component tanks. The piston 314 located in the quieting chamber 313 is in the foremost or advanced position, in which the plastic mixture, initially put out from the mixing chambers 301 and 301' and ejected by the pistons 306 and 306' in a cleaning stroke, is removed from the quieting chamber 313 at the end of a completed shot.

Accordingly, it would have been obvious to one having ordinary skill in the art, at the time applicant's invention was made, to have modified the mixing head and method of Schneider (US 4,440,500) such that the input mix chamber passageway is disposed in a non-perpendicular manner or at an acute angle to the outlet passageway as taught by Schneider (US 5,063,027) for the purposes of reducing spraying effects which may result in the formation of unacceptable air inclusions or bubbles in the finished product and to avoid air inclusions due to a spray flow (col. 3, lines 18-39).

16. Claims 3-6 and 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schneider (US 5,063,027) in view of Schneider (US 4,440,500).

The patent to Schneider (US 5,063,027) discloses all of the recited subject matter as noted above with the exception of the recited arrangement of the first and second nozzles.

The patent to Schneider (US 4,440,500) discloses the recited apparatus and method - see Figs. 1-4. The housing 10 has an input mix chamber passageway (the horizontal passage between the end faces of 24 and 34 as seen in Figs. 3-4) and an output passageway 12, the input mix chamber passageway communicating with the

output passageway (Fig. 4); a first nozzle 52 or 53 for injecting a first fluid into the input mix chamber passageway; and a second nozzle 62 or 64 for injecting a second fluid into the input mix chamber passageway whereby the second fluid can mix with the first fluid to form a mixed fluid; the first nozzle being configured to inject the first fluid into the input mix chamber passageway along a first axial line A-B; the second nozzle being configured to inject the second fluid into the input mix chamber passageway along a second axial line C-D; wherein the first nozzle and the second nozzle are configured to inject the first fluid and the second fluid into the input mix chamber passageway such that the first fluid and the second fluid meet at an intersection point 32; and wherein thee first axial line and the second axial line are not collinear (Fig. 3); wherein the first axial line and the second axial line are not coplanar (Figs. 3 and 4); and wherein the intersection point 32 is not located along a longitudinal axis of the input mix chamber passageway (Figs. 1 and 4); cleanout piston rod 14; input mix chamber passageway piston rods 24 and/or 34.

Accordingly, it would have been obvious to one having ordinary skill in the art, at the time applicant's invention was made, to have modified the mixing head of Schneider (US 5,063,027) such that the axial lines of the nozzles are not co-linear and not co-planar as taught by Schneider (US 4,440,500) for the purposes of effecting highly turbulent flow conditions in the mixing chamber but inducing a laminar flow pattern downstream so as to leave the dispense opening in a steady, non-splashing stream (col. 4, lines 6-30).

Conclusion

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The cited prior art discloses mixing heads.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Charles E. Cooley whose telephone number is (571) 272-1139. The examiner can normally be reached on Mon-Fri. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

19. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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13 May 2005